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Abstract

GENERAL DESIGN OF THE STEAM GENERATING HEAVY WATER REACTOR

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The S.G.H.W.R. evolved from the steam cooled heavy-water reactor which in turn evolved from the gas cooled heavy-water studies. The combination of design features in the S.G.H.W.R. results in low capital costs which is mainly a result of low heavy water inventory and a direct steam cycle. Fuel costs are also low due to good neutron economy. On-load refuelling and superheat is possible and large size units can be built without introducing new feasibility problems.

A 100 MW(e) S.G.H.W.R. prototype was selected for the U. K. development programme after separate surveys of light and heavy water reactors by the A.E.A. and by the nuclear Consortia. Development of nuclear superheat is provided for.

The fuel rods are of full core length and cluster spacing is obtained either by grids or by helical wire wrapping. In the boiling channels the fuel is clad in Zircaloy 2: the superheat fuel is clad in stainless steel.

The core comprises 112 Zircaloy pressure tubes (including 8 superheat channels) passing through an aluminium alloy calandria. Light water recirculates through the boiling channels, giving 13% exit steam quality by weight. Stainless steel was selected for the primary circuit with type 410 transition pieces to the pressure tubes.

Reactor power is controlled by moderator level, with moderator poison for long term reactivity changes and absorber fluid tubes for rapid shut down and possibly for flux trimming.

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Some Zr/Nb alloy pressure tubes may be included. Both flanged and expanded pressure tube joints between Zircaloy and stainless iron have been successfully developed. Expanded joints are preferred for their simplicity and replacement possibilities. The superheat channels have similar pressure tubes which are cooled and protected from superheat temperatures by a water cooled annulus and internal liner tube.

The heavy water in the moderator passes downwards through the core after cooling the calandria upper regions. Light water shield tanks surround the calandria.

The core assembly is housed in a concrete shielding vault which also forms a primary containment. A primary circuit failure would first be released to atmosphere through a condensing lute but before fission products could emerge the discharge would be diverted to the reactor hall, which surrounds the primary containment and is equipped with chemical clean up plant.

On-load refuelling is provided and the discharged fuel stringers are stored in a pond adjacent to the reactor.

S.G.H.W. physics problems arise from dual moderation and from light water boiling. The reactor is designed to give void coefficient which will ensure stability and safety. Isotopic changes during burn-up must be taken into account. Floodable displacer tubes permit adjustment of void coefficient during burn-up if necessary. Fuel management studies are in progress to determine the most economical method of power flattening.

A number of experimental features include loops for special irradiation and chemical experiments, and extra instrumentation.

The reactor is sited at the Winfrith Heath establishment of the Authority.